Gaze-Guided Narratives for Outdoor Tourism

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Workshop on HCI Outdoors: Understanding Human-Computer Interaction in the Outdoors at CHI 2018, April 21, 2018, Montréal, Canada

Abstract
Many outdoor spaces have hidden stories connected with them that can be used for enriching a tourist's experience. Previous work on locative media has suggested to include these stories by guiding users to relevant places through positioning technology. However, stories are often related to environmental features which are far from the user, far apart from each other, and therefore difficult to explore by locomotion, but can be visually explored from a vantage point. Telling a story from a vantage point is challenging since the system must ensure that the user can identify the relevant features in the environment. This position paper suggests using eye tracking for enabling *gaze-guided narratives* as a novel interaction principle. The idea is to tell a story based on its formal and location-dependent specification, and dynamically depending on the user's current and previous gaze on a panorama.

Author Keywords
gaze-based interaction; gaze guidance; narrative; storytelling; story graph; outdoor interaction; tourist guide

ACM Classification Keywords
H.5.2 [Information interfaces and presentation (e.g., HCI)]: User Interfaces

Motivation

Outdoor spaces offer a variety of opportunities and experiences for tourists. On the one hand, they facilitate physical activities, such as hiking, skiing or climbing. Previous HCI research has aimed at supporting these kinds of sportive activities in a way that contributes to individuals' health, well-being, and safety [3, 18]. On the other hand, outdoor spaces also feature unique opportunities for learning and entertainment [15, 8]. For instance, there seems to be a widespread interest in knowing the names of environmental features in sight, as can be seen in the prevalence of augmented reality (AR) apps, such as PeakFinder[1].

Many touristic outdoor spaces around the world have fascinating yet complex stories to tell, which are not easy to communicate through simple interaction approaches. Consider, for instance, the history and literary fiction connected with a Swiss mountain panorama (see next section and [9]), Romantic poetry related to the English Lake District [4], or the formation history of geological phenomena in a US national park. The plot of such stories typically involves more than one environmental feature and has narrative ordering dependencies. Previous work on locative media has suggested to tell these stories by guiding users to a sequence of relevant places through positioning technology [12, 4] or through magic lens-based interaction with maps such as in the WikEar system [17]. Often, however, a story involves environmental features which are far from the user and far apart from each other, but easy to explore visually from one (or a small set of) vantage point(s).

Here, we consider guides that tell stories to a tourist standing at a vantage point. A particular challenge is that the system must ensure the user can identify the relevant features in the environment. This position paper envisions *gaze-guided narratives*, a novel interaction principle which combines gaze guidance [11] with storytelling [13]. The idea is to track the user's gaze while telling a story about an outdoor space, and take the recorded history of visual attention into account for the continued narration. We suggest that gaze-guided narratives should be based on a formal and location-dependent specification of stories.

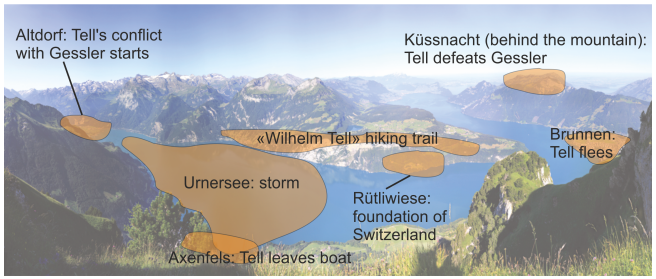

Figure 1: Story-related areas of interest for the Tell scenario (view from the Fronalpstock mountain looking towards Lake Lucerne). © Photo: Josef Schalch (http://mountainstamp.com/).

Figure 2: Demo of the gaze-based tourist guide for a panorama wall (exhibit at science fair).

[1] https://www.peakfinder.org/

Scenario: Swiss Mountain Panorama

We explain our vision with the scenario of a tourist guide that builds a gaze-guided narrative around the Swiss saga of 'Wilhelm Tell', a drama written by Schiller in 1804 about the struggle for freedom in which the hero fights against the despotic authorities, represented by the character 'Hermann Gessler' [16]. Figure 1 illustrates a number of places related to that story which can be seen from a vantage point on the Fronalpstock mountain.

We consider the following requirements:

(R1) The system must not be visually distracting in order to enable full immersion and unobtrusive user experiences [6].

(R2) The system should help the user correctly identify the places relevant for the story when they are mentioned.

(R3) The system should guide the user through the (not necessarily linear) story, but avoid patronization (e.g., not force the user to stare at one place for a long time).

(R4) The system should flexibly adapt to the user's interests (which are recognized from gaze).

Table 1 lists a possible gaze-guided narrative which evolves dynamically based on the user's gaze. The system provides information by audio, thus fostering a high degree of visual immersion contrary to displays (**R1**). Problems in visual search are detected and additional help is provided when necessary (**R2**, c, g). The system follows a pre-defined storyline (**R3**, a, b, d, f), but inserts extra information based on the user's interest (**R4**, e). The user is free to explore the panorama during long explanations (**R3**, a, d, e), contributing to high immersion (**R1**).

The following section describes the authors' related previous work. The final section concludes the position paper with an outlook on the next steps towards gaze-guided narratives.

Alice is hiking in the Swiss alps. She has reached a vantage point from where she can enjoy a view on Lake Lucerne (see Fig. 1). Her mobile phone vibrates and shows a notification that a gaze-guided narrative titled 'Wilhelm Tell's struggle for freedom' is available for her current position. She puts on her eye tracking-enabled goggles, plugs in the earphones and puts the phone back in her pocket.		
	System	**Alice**
a	Welcome to the story of Wilhelm Tell ... [introduction]	Alice freely explores the panorama while listening.
b	The Tell story is tightly connected to the myth about the foundation of Switzerland which is supposed to have taken place at Rütliwiese, a small piece of grassland on the opposite side of the lake.	Alice looks at wrong place.
c	Let me help you find Rütliwiese... [more detailed description]	Alice searches and finds Rütliwiese.
d	Yes, you found it. ... [starts story about Rütliwiese]	Alice listens and starts exploring the opposite hill.
e	[interrupts story]. By the way, there is a beautiful hiking trail along the hill you are currently looking at. It starts at Rütliwiese. ... [continues story]	Alice further explores the hill and Rütliwiese.
f	Now, let's start with the story of Tell. The story is about a conflict with Gessler, and it starts in Altdorf, a village at the left shore of the lake.	Alice searches.
g	Actually, you have looked at Altdorf in the very beginning. Do you remember?	Alice looks at Altdorf
h	...	

Table 1: Example for a gaze-guided narrative: the system guides the user and adapts its storytelling to her gaze.

Figure 3: Gaze-based tourist guide for a city panorama.

Own Previous Work

The GeoGazeLab at ETH Zurich has 7 years of experience with eye tracking in both indoor and outdoor spaces (http://www.geogaze.org/). Part of our research integrates gaze-based interaction as one type of interaction into location-based services (LBS) by combining positioning with mobile eye tracking (*Location-Aware Mobile Eye Tracking*, [10]).

Three types of spatial context can be used for this type of interaction [5]: the space interacting in (i.e., the user's position), the space interacted with (i.e., the environmental object looked at), and the spatial information interacted with (e.g., a map used for orientation in wayfinding). A particular challenge for Location-Aware Mobile Eye Tracking is caused by the movement of the user and/or the objects interacted with [2].

Here, we consider a stationary user interacting with static environmental features (e.g., mountains). A working prototype for these types of scenarios has been developed in the scope of the LAMETTA project (Location-Aware Mobile Eye Tracking For Tourist Assistance, http://www.geogaze.org/lametta/) [1]. Figure 2 shows the system at a science fair in Zurich (Scientifica, September 2017). The LAMETTA system has also been tested outdoors for city panoramas (Figure 3, [1]). In the current implementation, information about touristic places of interest is provided by audio based on dwell time, thus implementing an explicit interaction paradigm.

In one of our previous studies we have analyzed touristic gaze on a real world urban city panorama [7] with the goal of predicting the moment the user will get bored. Recognizing boredom could be useful for pushing novel information at the right moment (implicit interaction).

Outlook: Towards Gaze-Guided Narratives

The type of interaction we propose in this paper is neither fully explicit nor implicit. We envision a strategy that encompasses multiple techniques to reach our goal. Gaze-guided narratives are a form of interactive narrative storytelling where the storytelling process can be modeled as a trajectory through a state space [13]. The gaze actions of the user dictate the ordering of the story and in some cases its outcome, but at the same time it is important to maintain coherency in the narrative [14]. Story graphs as well as partially-ordered scripts provide formal models to enforce dependencies in the narrative, and we can build on these to create a formal model for gaze-guided narratives. User modeling based on gaze behavior in an outdoor setting in order to identify user interests is an open problem. We anticipate that bespoke user conceptual models will be necessary to create individuated gaze-guided narratives for different types of environments. Another key challenge is how to interpret gaze behavior as an indicator of user intent to make a shift in the story graph. We see these requisite components leading to a full program of future experimental research.

Acknowledgements

This work has been supported by ETH Zurich Research Grant ETH-38 14-2. We thank Lisa Stähli for helping with the content for the Tell scenario.

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